

## **QUALITY OF WATER IN TWO AREAS AFFECTED BY PAST MINING ACTIVITIES IN ALPINE CONTEXT**

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Abandoned mines can pose serious pressure on local water sources. Analyses of the possible water-related environmental problems connected to past mining activities was performed in two mining areas, Campello Monti and Gorno, NW Italy.

Campello Monti (Valstrona municipality, Piedmont region) is located in the basement of Southern Italian Alps in the Ivrea Verbano Zone. The area is characterized by mafic rocks (gabbros and pyroxenites) intruded by mantle periodite. Mines were used for nickel exploitation from 9<sup>th</sup> Century to 1940s. The groundwater circulation takes place in fractured rocks, waste dumps and tunnels used for mining exploitation. Strona stream and other minor creeks are located in the area.

Second site is in Gorno area (Lombardy region) where mines were used for zinc and lead exploitation. Zn-Pb mineralization is confined in a well known horizon, few ten meters thick and with an extension of about 80 km, called "Calcare Metallifero Bergamasco". This horizon, stratigraphically confined between a thick sequence of carbonatic platform limestones at the footwall and a siliciclastic lagoon sequence at the hanging wall, hosts several Zn-Pb-F-Ba ore bodies, extensively mined during the last millennium. Gorno is one of them: hereabout 10 Mt raw sphalerite, galena and calamine ores were extracted. In the area of Gorno passes the Riso Creek that empties into river Serio (Val Seriana). In the area dolomites and limestones outcrop and groundwater flow in the area takes place in fractured karst media with high permeability. Numerous springs and aqueducts are used for civil purposes.

In both areas there are lots of extractive waste facilities, represented by rock waste dumps, operating residues and tailings ponds.

To study the impacts on local water sources, water sampling campaigns and analyses were performed. At Campello Monti, 11 groundwater samples (1 tap water, 4 from tunnels and 6 from springs) and 6 surface water samples were collected. At Gorno, 17 groundwater samples (2 from tunnels, 1 tap water, 14 from spring) and 4 surface water samples were collected. The samples were analyzed to measure alkalinity, electrolytic conductivity, pH, temperature, metals (Hg, Tl, Cd, Cr (total), Cr (VI), Ag, As, Pb, Se, Ni, Co, Mn, Al, Fe, Cu, Zn, B) and other analytes (CN<sup>-</sup>, F<sup>-</sup>, Mg<sup>2+</sup>, Na<sup>+</sup>, SO<sub>4</sub><sup>2-</sup>, NO<sub>3</sub><sup>-</sup>, Cl<sup>-</sup>).

The water samples collected from mining tunnels of Campello Monti showed nickel concentration ranging from 31.9 µg/l to 304 µg/l (limit values of groundwater quality, Concentrazione Soglia di Contaminazione in Italy for Ni according to D.Lgs 152/06 is 20 µg/l). Sample from one of the springs was found to have Ni concentration of 57.8 µg/l and another one up to 266 µg/l and another secondary stream had Ni concentration of 512 µg/l. These all systems act as source to Strona creek.

The water samples collected at Gorno showed no contamination in both groundwater and surface water.

Both Gorno and Campello Monti are two areas that were affected by intense mining activity in past. The absence of contamination in water (groundwater and rivers) in Gorno compared to Campello Monti may be due to several concomitant factors apart from the different geological context: the higher pH of groundwater in Gorno, which facilitates the precipitation of heavy metals and the increased flow velocity in the karst limestone rocks in Gorno.

